



LIVE PRODUCTION SWITCHING – A NEW APPROACH

Corporate

Headquarters
+32 4 361 7000

North & Latin America

Headquarters
+1 947 575 7811

Asia & Pacific

Headquarters
+852 2914 2501

Other regional offices

Available at
www.evs.com/contact



MOTIVATION FOR A NEW APPROACH	4
PROBLEMS TO BE SOLVED	5
INCREASED REQUIREMENTS FROM LIVE PRODUCTION SCRIPTS	5
DISTRIBUTED PRODUCTION	5
VARYING PRODUCTION LOAD FACTOR	5
THE REASONS FOR THESE PROBLEMS.....	6
THE SOLUTION - KEY CONTRIBUTING FACTORS	6
REDUCING COMPLEXITY AND INCREASING FLEXIBILITY WITH GPU TECHNOLOGY	6
ADDRESSING DISTRIBUTED AND REMOTE OPERATION WITH IP.....	7
ADDRESSING SCALABILITY WITH MODULARITY	7
MORE ON REMOTE OPERATION WITH IP	7
REALISATION IN A PRODUCT	8
IMPLEMENTATION IN THE DYVI PRODUCT	9
PROCESSING ELECTRONICS	9
EXPANDABLE CONTROL PANEL FOR LIVE OPERATIONS.....	10
NETWORKING DYVI MODULES	11
OUTSIDE BROADCASTS AND MULTI-VENUE BROADCASTS.....	13
GPU-BASED PROCESSING.....	15
OTHER DYVI RESOURCES	17
INTERNAL RAM RECORDERS AND STILL STORES	17
CONTROL GUI.....	17
MULTIVIEWER OUTPUTS	18
TALLY OUTPUTS	19
CREATIVE OPERATIONS WITH DYVI.....	19
ELEMENTS OF DYVI CONTROL	19
MIGRATING ONWARDS FROM STAGE MODE.....	21
DYVI “SCENES” MODE	22
DYVI “STORY” MODE.....	24
OTHER DYVI OPERATIONAL FEATURES	24
SOURCE-BASED CLEAN FEED ARCHITECTURE.....	24
CONDITIONAL MACROS	24
SUMMARY	25
MODULARITY IN ELECTRONICS AND CONTROL PANEL CONNECTIONS.....	25
MODULARITY IN OPERATIONS.....	26
THE LAST WORD	26



LEGAL INFO

© 2013 EVS Broadcast Equipment, all rights reserved.

No part of this documentation or publication may be reproduced, transcribed, stored in a retrieval system, translated into any language, computer language, or transmitted in any form or by any means, electronically, mechanically, magnetically, optically, chemically, photocopied, manually, or otherwise, without prior written permission from EVS Broadcast Equipment.

DISCLAIMER

The information in this document is believed to be correct as of the date of publication. However, our policy is one of continual development so the information in this guide is subject to change without notice, and does not represent a commitment on the part of EVS Broadcast Equipment.

TECHNICAL SUPPORT

For the latest news, upgrades, documentation, and products, please visit the EVS website at www.evs.com.

LAST UPDATED

21 January 2015



Traditionally, hardware resources in the production video switcher have been aligned to creative requirements by using multiple mix/effects (M/E) levels with their associated processing, in combination with a source-switching bus matrix. Driving this complex device requires skilled operators with good intercom coordination to synchronize the operation of the video switcher's resources to the live transmission script, as well as controlling additional resources (graphics, slo-mo replay, etc.). At the same time conflicts between these resources have to be avoided.

MOTIVATION FOR A NEW APPROACH

For many years, although there has been an increase in the scale and efficiency of technologies used in broadcast production, the underlying bus matrix and M/E architecture in video switchers described above has remained much the same. In meeting today's broadcasters' needs in even more ambitious projects, this stagnation in switcher architecture has resulted in great complexity in the installed switchers of today and their correspondingly complex operation. These factors have caused the continuing need to use large crews in order to manage live productions successfully with a minimum of operational errors.

At the same time, broadcasters need to solve quality and reliability issues with broadcasts involving long distances and remote control. Traditional switcher design is not helping in these respects.

It is time for a new approach, using new technology and tools from outside the traditional broadcast equipment supply industry in order to confront and solve these issues.



PROBLEMS TO BE SOLVED

INCREASED REQUIREMENTS FROM LIVE PRODUCTION SCRIPTS

Covering major live events today – news, sports, etc – is an order of magnitude more complex than even a few years ago. In sports coverage, size reduction and increased portability of cameras has multiplied the number involved at a single site such as a stadium from a handful to dozens. Slow motion action replay effects are expected on every camera covering live on-pitch action. Complex statistics about scores, players, teams, league tables, etc. are expected on screen nearly all the time. With the contracting out of coverage from national broadcasters to independent producers, on-screen branding is now much more in evidence.

The live production switcher is at the core of all this increased activity and complexity, yet the real time clock ticks at the same speed as ever and production crews are expected to execute their creative intent live on air as accurately as ever at all times.

DISTRIBUTED PRODUCTION

A live sports compilation broadcast today is expected to cover events from multiple geographically-separated sites. This can mean stadiums in more than one country or even more than one continent. News programs are expected to bring live coverage of breaking stories from wherever they are occurring in the world, with on-site reporters providing updates in two-way video conversations with the studio anchor. In addition, the local sites will have compiled and uploaded packages giving the general situation to the central news studio. Many of the sites involved therefore require production capability, not just camera sources, and therefore require production switchers. During a transmission, the source switching point may move from the central studio to a remote site and back again, many times. Throughout this, the viewer expects to see no change in quality from cameras in the same country to cameras in another continent, and no disturbances due to timing glitches, no matter how complex the transition between sources.

Television production and distribution facilities, and the live production switcher in particular, have been profoundly affected by the increasing complexity of signal timing, control hierarchies, and associated factors arising from the globalisation of television event coverage.

VARYING PRODUCTION LOAD FACTOR

How has classic production switcher design evolved to meet these increased demands? The answer is: very little. The switcher has certainly become bigger in terms of the number of inputs, mix/effects levels and keyers provided in the processing electronics, with a corresponding expansion in the physical dimensions of the control panel. The digitization of the analogue video signal in the 1980's certainly helped to contain the signal quality and timing consistency challenges arising from the increased resource complexity.

In basic philosophy, however, the production switcher has retained its bus row and crosspoint structure, but with a linear scaling of this core structure size to accommodate more inputs. It has also cascaded multiples of this structure (multiple mix/effects levels) in a fixed hierarchy to accommodate increased complexity of effects, such as more keyers and more layers of keying.



Other effects and resources have been “bolted on,” for example still stores, RAM recorders and digital video effects (DVEs). Although integration of these resources has improved, interface issues have persisted, such as timing glitches when DVEs are keyed in and out of a composite image, delays being added when cascading DVEs, input and/or output scaling problems, etc.

All of this switcher resource expansion has been crammed into the single processing electronics frame, so it has simply become larger. Production switchers are of course available with user choice in the number of inputs and mix/effects levels, so those equipped with fewer resources do have smaller electronics frames and control panels. However, the monolithic, non-scalable nature of the frame means that users have to equip their production systems with a large “worst-case” capable switcher, because of the severe impact on continuity of broadcast output in the event of a forced installation of an even larger switcher arising from unexpected growth in demand.

Such worst-case provisioning has two main impacts: on the one hand, for much of the time large proportions of the switcher resources will be lying idle, since, on average, most productions will not use all of them, which means that the user is stuck with large size, high power consumption and heat dissipation with no benefit in return; yet on the other hand, the chances are that the envisioned “worst case” scenario may in fact be exceeded by some new event, and the disruption of switcher replacement may then have to be faced after all. If the user is responsible for multiple sites requiring large production switchers, this provisioning inefficiency is multiplied.

THE REASONS FOR THESE PROBLEMS

How did it get to be this way? The real problem is that the control interface presented to the creative operator in live on-air production has remained literally a map of the underlying fixed-hierarchy hardware. On the control panel, the bus rows and crosspoints in the frame translate into button rows extending horizontally, and the fixed layering forced by cascading of bus rows via reentries in the electronics translates into many button rows in mix/effects layers extending vertically. That can distract creative minds into thinking about what the hardware is doing rather than how to get the desired effect.

THE SOLUTION - KEY CONTRIBUTING FACTORS

To find a solution to these issues we need to look into other industries to see what has been happening outside the television broadcasting world.

REDUCING COMPLEXITY AND INCREASING FLEXIBILITY WITH GPU TECHNOLOGY

Today’s production switcher needs to be as much an image layering device as a video source selector. Not only that, but there must be no restriction in the ordering or re-ordering of layers in relation to sources. In addition, any source or combination of sources must be capable of spatial manipulation between input and output, in terms of cropping, repositioning, scaling, and rotation in three axes, in coherent relation to other sources. Each source must also retain ‘ownership’ of its individual or group color correction settings and other image control settings throughout all these manipulations, no matter how many other sources it is composited with.

All of that is quite hard to do in conventional production switcher architecture. It is much easier to do in the architecture of a Graphics Processing Unit (GPU) as used in computer games technology. In fact, since the source



pixels have already been created, only a fraction of the GPU's massively parallel resources are required even for large numbers of highly complex video manipulations in parallel. Spatial resolution is also not a limiting factor, being already future-proofed for UHDTV. Layering is greatly simplified by the GPU's built-in Z-axis manipulation system, with mature algorithms in place for determining a layer's priority by Z-distance from the viewing plane in combination with its transparency. This single point of application of layering priority is just one of the distinguishing benefits of GPU-based video processing.

ADDRESSING DISTRIBUTED AND REMOTE OPERATION WITH IP

The studio domain is based on the SDI interface, but SDI cannot extend outside a small area. "Extra-studio" or long-distance digital signal transport is in the hands of telecommunication companies that use entirely different protocols. However, the intra-processing domain of the GPU also uses non-SDI protocols. A common link between "intra" and "extra" data domains is IP-based routing technology with associated packetization. IP routing then creates a solution to the integration of remote sites with the processing GPU without going through the local SDI domain, as long as an IP gateway as well as an SDI gateway can be provided into the GPU.

ADDRESSING SCALABILITY WITH MODULARITY

At the same time, the IP gateway allows a further possibility: instead of being constrained to a single monolithic and non-scalable electronics frame, the total resources required by a switcher for a particular production – its inputs and its processing – can be divided up across multiple processing modules interconnected via IP. Local video inputs and remain connected as imports and exports via SDI interfaces, but there is now a common point of confluence of all inputs in the IP domain within any one of the modules, and also of the processing power of all modules via the IP domain. The site at which any one of the processing modules is located can be designated as the "main" processing site that creates the on-air output. A 'main' control room is also assigned – not necessarily at the same location as the main processing module and not necessarily at the event site – accessing all processing modules together as if they were one, and with all video inputs available as if all were local. Alternatively, control can be partitioned across sites, with some remote sites being responsible for their own partial pre-production of their feeds to the central main site. Many other permutations of sites, resources and control are possible, in order to match the requirements of the production workflow. Like the interconnected video data, control commands and status data travel via IP.

Overall, the user does not have to purchase more input resources or processing power than is needed for present requirements, because the modularity is inherently expandable from a single module on upwards.

MORE ON REMOTE OPERATION WITH IP

IP is just a routing technology. That means it is insensitive to distance (lower layers take care of physical issues). In turn that means an IP-linked modular switching system as outlined above can potentially have its modules separated not just by inches or centimeters in a rack, or meters between racks, but by miles or kilometers or even thousands of miles or kilometers between continents. It also means that for outside broadcast operations, it is not necessary to transport a production facility to the venue at all. All that is required besides the cameras and their associated SDI cabling is one or more processing modules and associated data links. The control panel and associated monitoring does not have to be there. It can be at the studio center instead, whether in the same area or in another country. This



complete flexibility in the geographical relationship of venues and production centers is one of several key points that the remainder of this white paper expands on.

REALISATION IN A PRODUCT

The three technologies outlined above – GPU-based processing, IP interconnection over any distance, and modularity of resource and control provision – form the basis of a new product – the DYVI Production Switcher system.

DYVI integrates these technologies in a broadcast-specific architecture that is radical in its fundamental design, but which interconnects easily with existing broadcast infrastructure via SDI and with telecomm providers via IP over dark fiber or Metropolitan Area Network grade low-latency connections. No compression is used in video processing.

In addition to the benefits obtained for remote site linking, the modular approach adopted in DYVI gives further advantages. In a system using multiple modules, processing load balancing is easily achieved by software reallocation of each module's resources in relation to individual control sites, i.e. one site can grab multiple modules' resources or conversely can donate unused resources to another site needing them, without any physical relocation of electronics frames or control panels. By the same token, this distributed architecture would potentially allow the design of a system with automatic redundancy failover, with minimal disruption to service compared to conventional systems.

However, it is not necessary for the DYVI user to be equipped with a multi-module, distributed site installation in order to benefit from the advantages implemented in this product. A user can begin with a single processing module and immediately obtain the benefits of GPU-based processing with its powerful flexibility in building effects. Whether creating simple or complex effects, DYVI's operation remains inherently clear and logical to the creative user instead of imposing the requirement for an excessive burden of knowledge about the hardware "under the hood."

One thing about DYVI will look familiar, however, and that is the control panel. At first glance, it certainly looks like the control panel of a conventional switcher. In fact it has an optional mode of operation that in many ways allows the control panel to be laid out to simulate something like the familiar form of a multi M/E switcher, with re-entries into a main Program/Preset bus or any M/E bus. However, that would not be the whole story, because the software architecture of DYVI fully exploits the new-found flexibility of GPU-based processing, and allows the user to apply some quite different modes of operation to the same control panel. Since, in principle, any button on the panel can be set up to perform any function, and can have that function changed dynamically, the possibilities are immense, yet are deliberately focused into some particular operational modes that are innovative yet make absolute sense in creative terms. The operations section of this paper will describe some of these modes in outline.

IMPLEMENTATION IN THE DYVI PRODUCT PROCESSING ELECTRONICS



Figure 1. DYVI Processing
Module

Instead of using a single electronics frame for processing, and making it available in “small,” “medium” or “large” sizes, the DYVI production switching system divides the processing load required by the user across an IT network of relatively small (2 rack units) Processing Modules. Each Processing Module is fully-equipped with all functions and has a central core consisting of standard components such as a high performance server, GPU processor and multi-Gigabit Ethernet network interface. This central core operates in a computer graphics format domain and interfaces with the SDI video domain via proprietary SDI I/O cards. With each card providing 8 SDI inputs and up to 6 SDI outputs, and four card slots available, an overall SDI connectivity of 24 inputs and 6 outputs (alternatively 16 inputs and 12 outputs), can be achieved per Processing Module. Inside the module, the signals remain uncompressed throughout.

To increase the number of inputs, outputs and total processing power, multiple Processing Modules are networked together (see “Networking DYVI Modules,” below).

EXPANDABLE CONTROL PANEL FOR LIVE OPERATIONS

The DYVI control panel has a two-control level layout, each level with touch screen, transition fader and transition control buttons. The basic version comes with 24 source buttons (Figure 2).



Figure 2. DYVI Control Panel with 24 source buttons

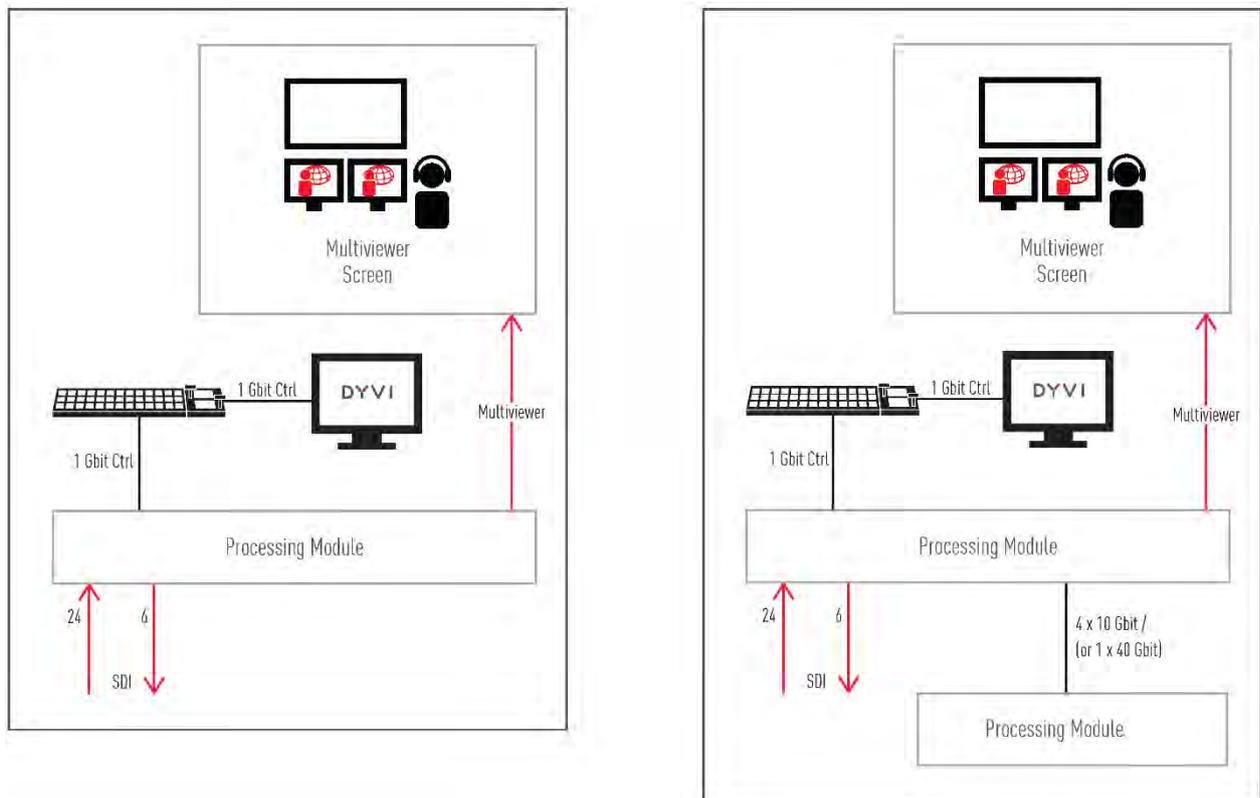


Figure 3. DYVI Control Panel with two extension modules (40 source buttons)

It can be expanded with up to four 8-button extension modules to a maximum of up to 56 source buttons per row. (Figure 3 shows a panel expanded with one extension on each side to make 40 source buttons). However, the DYVI “Scene” concept of building productions and user programmable button mapping allows big shows to be run even with the un-extended panel, instead of a much bigger traditional panel. Note also that the panel does not need to expand vertically (more levels) – see “Creative Operations with DYVI.”

Control panel configuration is via a separate dedicated Control GUI that remains available for instant changes during live production.

NETWORKING DYVI MODULES



Figures 4a and 4b. DYVI systems with single and dual Processing Modules

Figure 4a shows a simple DYVI system such as might be used for a self-contained local studio or production center. One Control Panel and a GUI are connected to a single processing module.

Figure 4b shows a larger system where a second Processing Module has been connected using four 10 Gigabit Ethernet network connections.* In this figure, the upper module acts as the main module – broadcast outputs are taken from it – and the lower module acts as an augmentation module, doubling the number of inputs and the number of outputs. The interconnection occurs in the format of the central processing core, i.e. a computer graphics format, with the inter-Processing Module linkage provided by the network connections. Timing of all the inputs is automatically adjusted to the same synchronization point. The video processing power of the two modules is also combined. In this way, each Processing Module can be thought of as a production switcher server, such that the combination of the fiber network with each “server” produces a larger virtual production switcher.

Processing Modules can be separated by short distances (local clustering), or by very long distances via MAN-class connections (multiple 10GbE). Timing between all video inputs remains synchronous. Systems latency does not necessarily increase in direct proportion to the number of modules because they do not operate on a series or re-

* Alternatively, the network interfaces can be configured to use a single 40 GbE fiber connection.



entry basis; video delay, including the SDI I/O frame buffers, can be minimized to 3 frames in a single unit system and to 5 - 6 frames in cascaded architectures (progressive video format).

Control panels can also be separated from Processing Modules by short or long distances, depending on the type of production.

This flexibility of location of the different components of a DYVI system has big implications for the way in which outside broadcasts and multi-venue productions can be produced. It has an even bigger potential impact on multi-national event productions.

OUTSIDE BROADCASTS AND MULTI-VENUE BROADCASTS

More Processing Modules can be added to make a larger switching system. As with the case of just two Processing Modules interconnected, the additional inputs and additional processing resources exist timing-wise in parallel, not in series. The only further effect on timing that occurs in larger systems with greater distances of separation of modules is due to the latency of the network links themselves; this is 1 ms per 200 km (1 ms per 124 miles) one way in dark fiber. However, in the Processing Module appointed as the “Main” output unit, the timing of the inputs from all modules is automatically adjusted to match the most delayed inputs, as per normal practice.

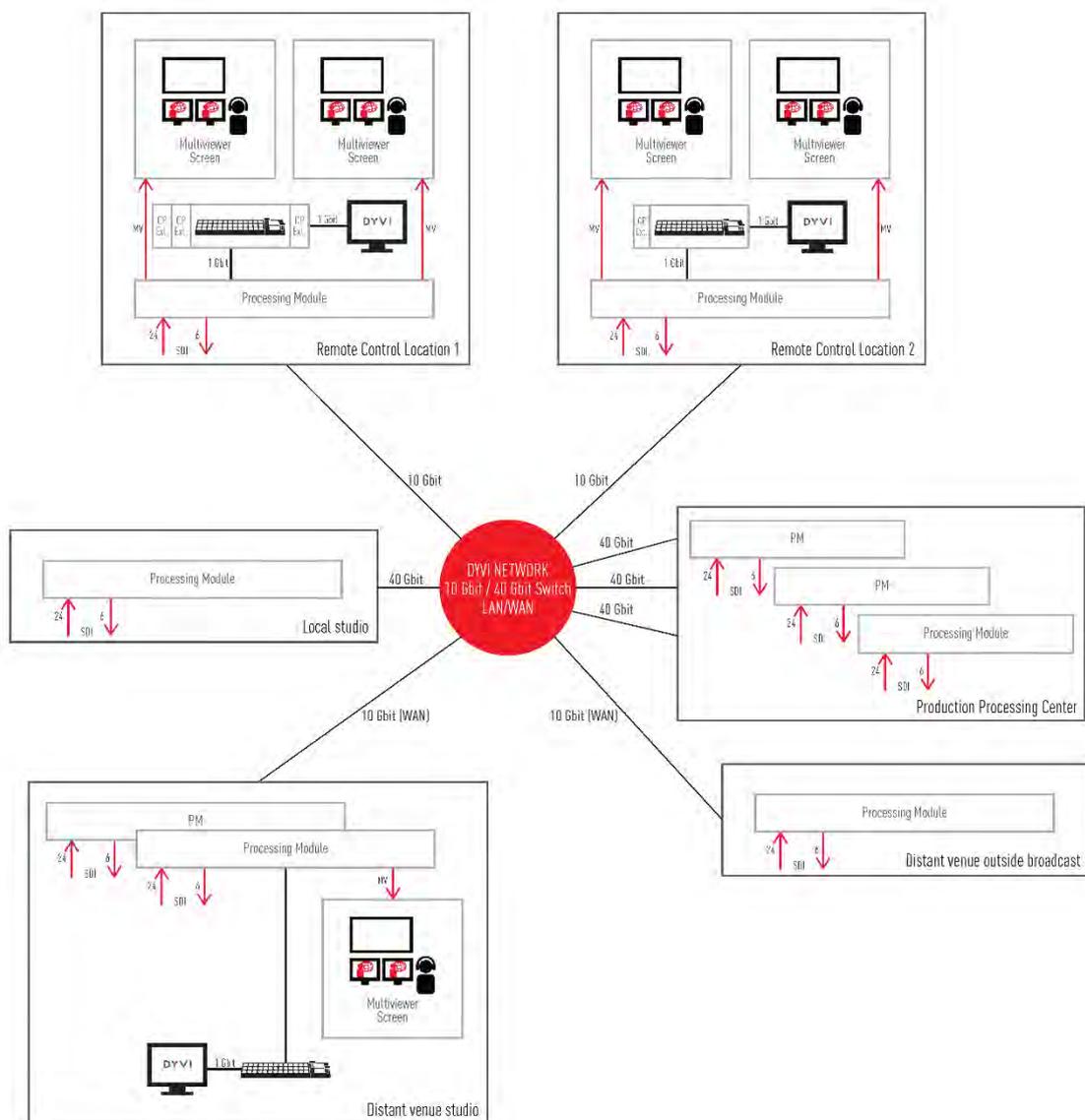


Figure 5. Large multi-site system, with local and remote event and



Figure 5 shows a more extensive production system, containing a total of nine Processing Modules. A separate Network Switch is used to manage all their interconnections while maintaining full data rate on each circuit. The middle right part of the figure shows a Production Processing Center with three Processing Modules. This could be located in a central equipment area and have access to extensive video input resources. In the middle left there is a local studio with a single processing module for a small number of camera inputs. This might be in the same complex as the Production Processing Center, but in a separate equipment area. Neither of these two areas has to have its associated production switcher control panel located nearby.

The areas at the top of the diagram – Remote Control Locations 1 and 2 – are where the production crews would be and this could be anywhere, but one crew might be located in the same broadcast complex and the other at a regional complex, for example. One could be switching the main program; the other could be editing or pre-packaging stories for use later in the main program.

The really interesting part is what happens in the lower part of the figure. At the lower right a “Distant venue outside broadcast” is shown, but it doesn’t have to be quite like the outside broadcasts we are used to. Control and monitoring is not present there – that’s happening at one of the Remote Control locations 1 and 2. What that means is that this could now be a “truck-less” outside broadcast. Only cameras and operators and one DYVI Processing Module need be sent there, provided there is a point of presence for the WAN connection, and it’s reasonable to expect that venues such as stadiums are being equipped with these as a matter of course. Even if engineering control of cameras is desired locally, rather than over the network, the DYVI processing module can be configured to provide switchable outputs of its individual camera inputs for this purpose.

The lower left part of the figure shows a distant venue studio with its own local control panel and multiviewer. The point this makes is that the overall system can mix and match processing and control points on a completely free and flexible basis. In the case of this distant venue, it might be that for reasons of latency or just of tighter involvement of the production team with the local event or activity, it is considered better to have production control right there on the spot. It would be likely then that the one of the main control points – Remote Control Location 1 or 2 – would take this studio’s output as a pre-switched event coming in as a single remote source. However, at any time, and on a very rapid basis, the configuration of what is controlled from where can be changed.

GPU-BASED PROCESSING

We tend to think of the signal flow path of traditional production switchers as a “waterfall” configuration, in which sets of keyers are associated with particular Mix/Effects levels. The advent of digital processing has enabled fairly flexible reentry of Mix/Effects levels, and features such as Resource Masks, Source Button Assignments and Macros can help to disguise the complex interconnections of the underlying hardware. However, the operator always has to be aware of the architectural structure of the switcher; this can be a distraction from the creative task of switching the program.

In DYVI, the architecture is radically different, being built around a GPU real time rendering engine. One way to think about it is that instead of using arrays of crosspoints on individual buses feeding into several distributed effects processors (“M/Es”), the switcher conceptually uses a single convergence point for all video sources, this convergence point being located inside the GPU.

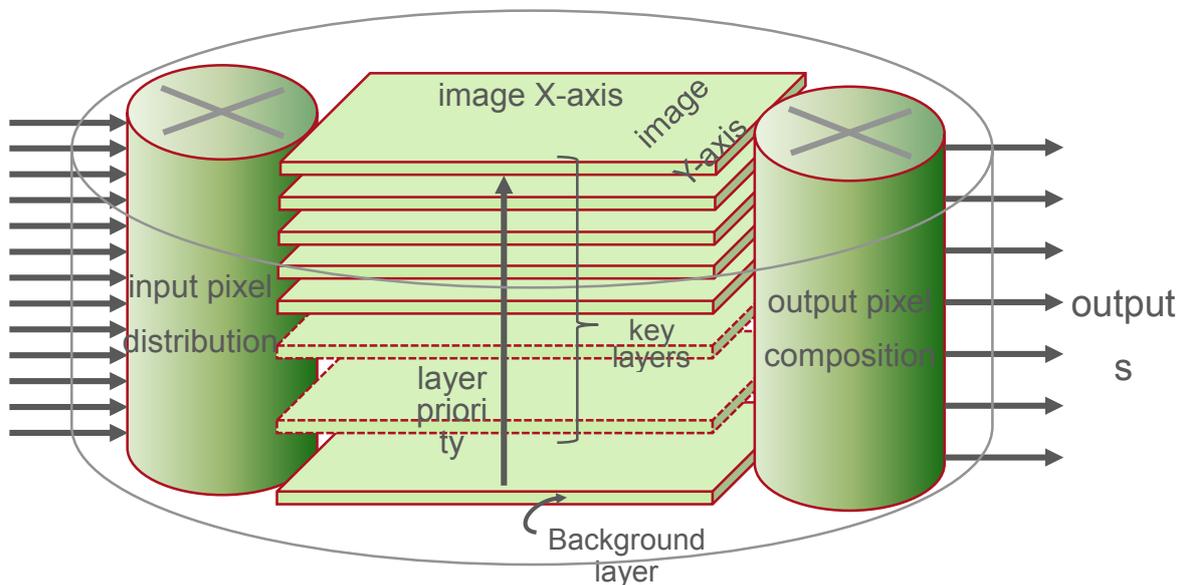


Figure 6. Conceptual view of GPU operation as a video production

Figure 6 is a conceptual view of the GPU performing the rendering function in the production switcher. At any intersection of an output image x-axis location and y-axis location, the output pixel values will be formed according to values generated by bus transition generators in conjunction with keyers. Those values are applied to each input pixel’s layer priority value, determining its priority in forming an output pixel.

By generating offsets and multiplier values, input images can also be cropped, scaled, repositioned and rotated in any of the X, Y and Z axes. For 2D effects, this is sufficient.



Figure 7. Multiple-cascaded 3D DVE effect, with fully-intersecting

For 3D effects, the process is taken further; individual input objects must be related correctly to each other inside a 3D coordinate space. This is shown in Figure 7, which shows the GPU creating a complex multiple-cascaded DVE effect with correct 3D relationships between the objects in the composite image. Note that individual 3D object channels are able to intersect each other's image planes correctly without limitation.

In DYVI, the DVE function is effectively present at all times because it is an integral part of the GPU rendering engine and the software that controls it. This is why in DYVI there is never any timing change in the output when a DVE effect starts or stops. Even multiple cascaded DVE's will not add more delay to the signal as they do in generic multi-M/E architecture video switchers.

More generally, however, this software-controlled GPU-based architecture allows almost infinite reuse of images and compositions of images in larger "nested" compositions. Every permutation exists as a separately identified "object" that can be named to make it recognizable and meaningful to the operator. This is the essence of the DYVI "Scene" concept, which will be one of the topics discussed in the "Operations" section.

In terms of processing power, DYVI's GPU-based architecture cannot be compared directly to the purely hardware-defined processing architecture of traditional production switchers. In a conventional switcher, the available processing resources are utilized to the same extent regardless of the complexity of the video streams that make up a composited effect. In DYVI's GPU-based processing, on the other hand, the complexity of the video streams does make a difference.

This is because, when a large number of video sources are keyed simultaneously onto the main Program output, they will probably not all be full-screen images; instead they will more likely be cropped and scaled to smaller dimensions (number of pixels), and any transparency factor on any of them will occur only temporarily during transitions. Since the GPU is reconfigured by software for each event in real time, advantage is taken of this situation, i.e. the processing load at a certain video time frame becomes a lot smaller, because what matters is the number and size (in pixels) of the video streams transported into the GPU. The benefit of this architecture is then that even with just a single Processing Unit, a DYVI switcher system can be running without any system stress at all a production setup equivalent to that of a multi-M/E switcher.

OTHER DYVI RESOURCES

INTERNAL RAM RECORDERS AND STILL STORES

Each Processing Module provides eight RAM Recorders, with video + alpha (key) channels.

Each DYVI switcher system also provides a bank of Still Stores which can be used individually or cloned to all Processing Modules in a multi-module system.

CONTROL GUI

The DYVI Processing Modules are controlled by a Control GUI that is displayed on a PC supplied with the DYVI system. It provides an independent configuration interface and monitoring unit during production setup and in live operation. Touch screen support is included. If necessary, several instance of the GUI software can run on different PC, giving parallel control of the system. The GUI program supports Linux and Windows 64 bits Operating Systems. An example of a Control GUI screen showing a combination of setup menus and video images is shown in Figure 8.

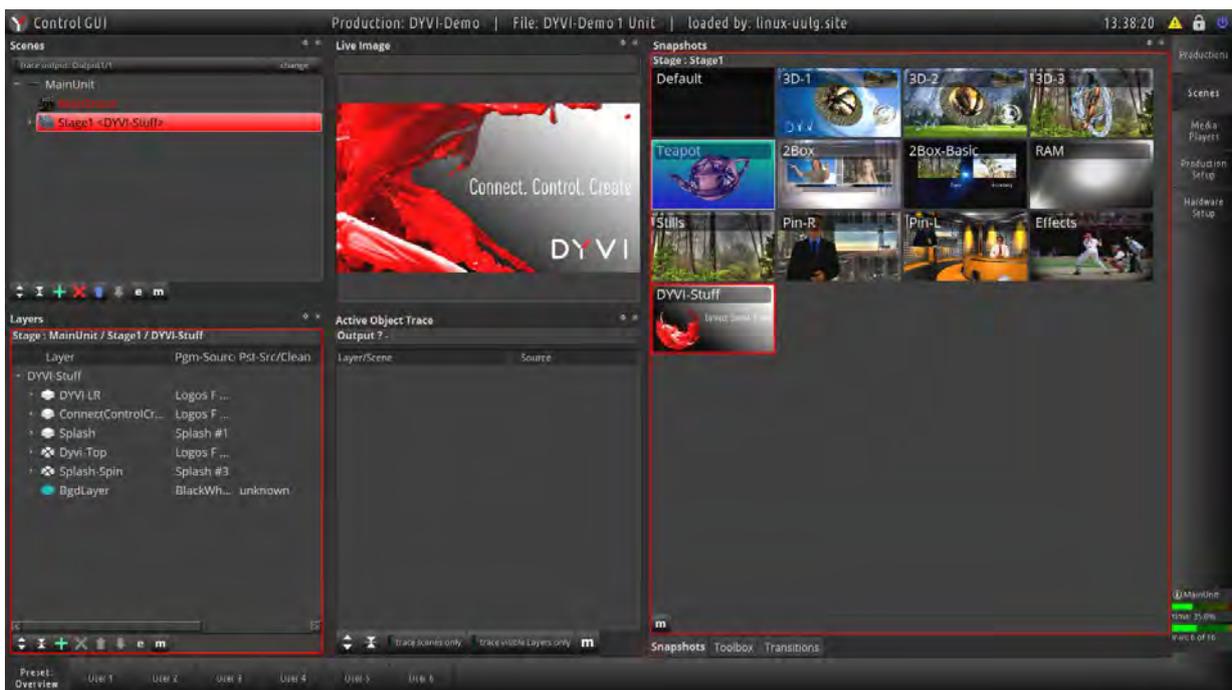


Figure 8. Control GUI

MULTIVIEWER OUTPUTS

The DYVI system generates its own multiviewer outputs, so a separate device to do this is not required. DYVI produces two outputs per Processing Module and these are available as HDMI outputs for connection to a computer display. For longer connection distances, a multiviewer output can alternatively be routed to an SDI output for connection to a broadcast monitor display, or, for even longer distances, to a remote Processing Module via the network connections. Figure 9 shows a multiviewer assignment map created by one of the preset multiviewer formats, as it appears on the Control GUI. The example shown splits the screen 10 ways, but other presets are available from a single image to a 16-way split. A multiviewer display split many ways is useful for large switching systems with many Processing Modules (therefore with many Preview outputs), because the high degree of multiplexing (up to 16 sources combined on a single HDMI cable) saves having to use valuable SDI outputs for this purpose, as well as a lot of cabling. In addition to the factory preset choices for multiviewer splits, custom multiviewer splits can also be set up.

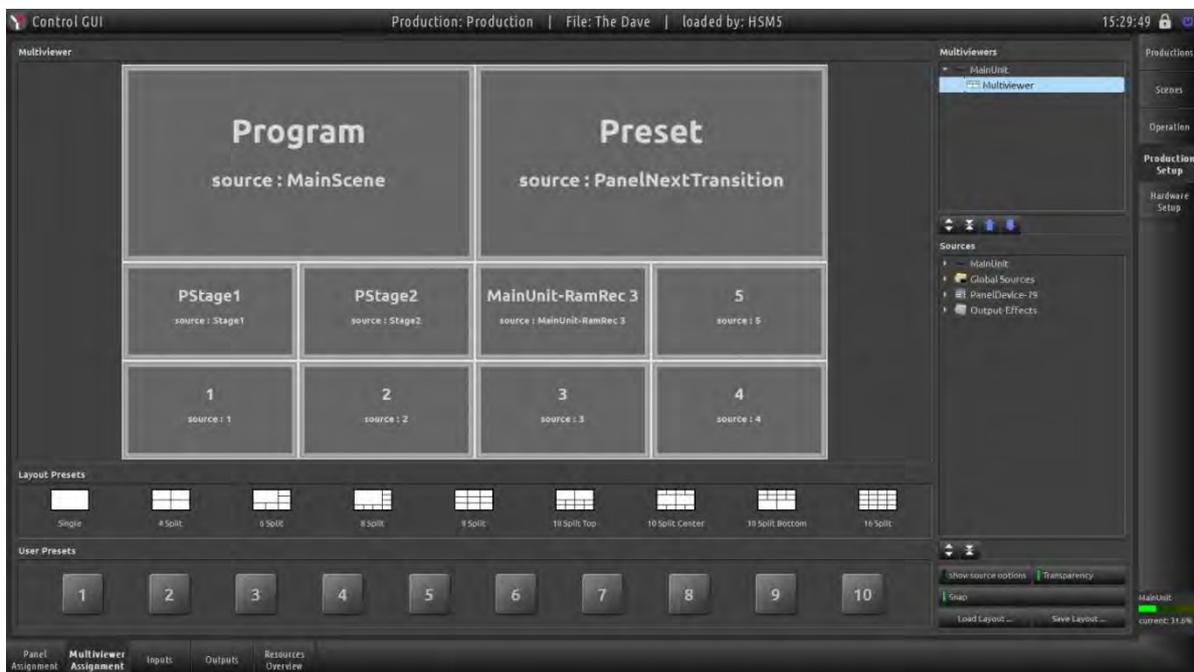


Figure 9. View of Multiviewer



TALLY OUTPUTS

When any source is used in any effect, key or DVE that appears on-air, no matter how small a part it plays in the effect (which could be a complex composite of many sources), and no matter how complex the route is between the source and the on-air output, a tally signal will be sent back to that source to signal that its contribution is visible on-air. In the case of sources that contribute to different variants of the switcher output (e.g. isocam feeds, different versions of clean feeds, etc.), users can choose between 32 independent sets of tally systems to be sent out, or another type of setup that makes additional tally logic combinations such as AND, OR and ExOR from the tally outputs. In all cases, tallies switch with very low latency.

The tally outputs from the Processing Modules, both main and extension/remote, can be connected to external tally systems for distribution over Ethernet LAN or RS-232/422 systems.

CREATIVE OPERATIONS WITH DYVI ELEMENTS OF DYVI CONTROL

The combination of one or more Processing Modules with one or more Control Panels and with Multiviewers that makes up a DYVI video production switching system is highly configurable for operations. A particular configuration (for a particular broadcast, or task within a broadcast) is called a “Production” and it will define how the various components of the system behave under live operational conditions. Getting the configuration of a Production right makes the components behave exactly as desired for a particular task.

There are three parts to a DYVI Production setup. The first is called “Connect”. This refers to the bringing in of the input sources needed, which may be a subset of all those physically available, and logically connecting them to the processing stages. It also includes setting up the subset of sources available as key sources. Setting up the desired outputs (main Program, Preset, any “Stage” outputs (see definition below), clean feeds, etc., is another piece of the “Connect” part of Production Setup. “Connect” also includes how the functions in the Processing Module are mapped to regions of buttons on the Control Panel, and also how the various outputs are arranged and displayed on the Multiviewers.

The next part is “Control.” This refers to the definition of how various elements will behave within the Production, and includes choosing the priority of each layer arising from a key operation.

Finally, there is the “Create” part, which is simply to start using, live on air, the customized Production Setup you have just created.

Each and every different Production Setup can be named and stored for rapid recall (the DYVI system reacts to a change of setup in a fraction of a second). To help new users get started, a “New Production Setup Wizard” is available. This has a number of built-in defaults. What this Wizard will do if its defaults are accepted, is create a setup that simulates the operation and control panel layout of a traditional production switcher. Figure 10 shows how this Wizard is presented on the Control GUI.



Figure 10. New Production Wizard appearance on DYVI

Figure 11 shows an example of how the control panel might appear after setting up a Production with this Wizard. The left two-thirds region of the upper level of the Control Panel has been divided into two areas intended to simulate “Mix/Effects” levels on a traditional switcher. DYVI calls these areas “Stages.” Placing them side by side instead of above each other creates the equivalent of a “2 M/E” switcher, but without expanding the control panel vertically. Any overflow of the number of input sources compared to available crosspoint buttons per Stage automatically creates Shift levels as required. The Stage outputs can be assigned to separate video outputs, like “M/E” outputs, if desired.

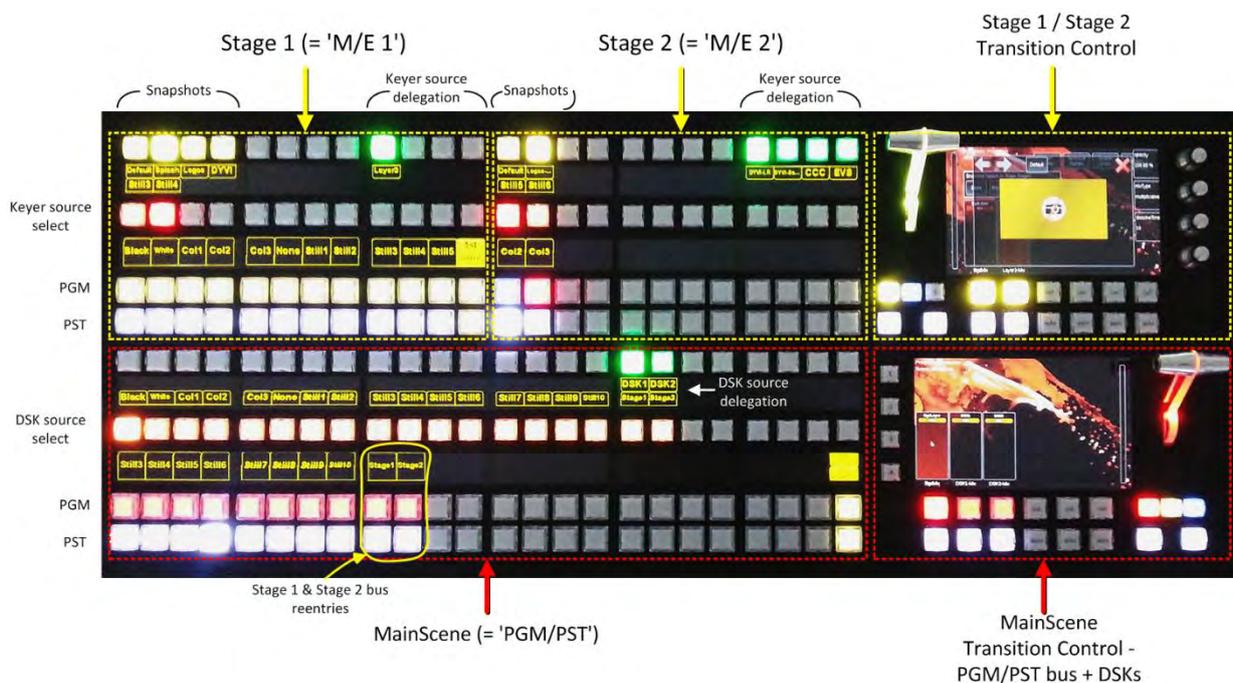


Figure 11. Control Panel layout of a Production Setup with



Within each Stage, the bottom two button rows are the Program and Preset bus rows, the row above that is the Keyer sources. These change dynamically according to which keyer is delegated to the source selection buttons; in this particular Setup there are four keyers, and the delegation buttons for them occupy the right-most four buttons of the top button row in each Stage.

That leaves eight buttons remaining at the left end of the top button row in each Stage. In this Setup, these are placeholders for DYVI “Snapshots.” Snapshots are similar to effects memory recalls. Each one will impose a particular state on the panel, and therefore on the switcher outputs. One of the default snapshots supplied by the Wizard sets all bus rows to black and all keyers off; this is a common starting point for sequences of effects on a switcher. Other snapshots may set particular background colors, or, if desired, more complex effects.

However, assignment of control panel buttons via the Wizard is not the only method available; there is also a much more flexible User Assignment mode that allows almost any layout the user wishes to be built on the control panel. For example, there is nothing to prevent the assignment of, say, 16 Program buses in one contiguous block!

All buttons are identified by OLED names above or below them. The names change dynamically, for example, the various different sources available when keyer delegation changes.

Buttons are color-coded to make the different areas of the panel distinct from one another, with the Wizard supplying some default colors (e.g. red for any source that is on air, yellow for Stage bus rows, green for key delegation, etc.). However, the user can override this with any desired color scheme (even the transition fader’s internal illumination will follow the color of the Stage buttons, when these have been customized).

MIGRATING ONWARDS FROM STAGE MODE

The purpose of the “Stage” mode of operation is mostly to provide the new DYVI user with a sense of familiarity, by forcing the DYVI switcher to adopt a familiar kind of behaviour and some artificial limits that make it seem like a traditional multi-M/E style production switcher. These limits include a fixed pattern of reentries of Stages into the “main” output Program and Preset buses, when in fact DYVI doesn’t actually need to have any restrictions of this kind. However, many of the advantages of DYVI do start to emerge in this mode, before the user even starts on the more advanced modes described below. For example, the user can deliberately limit the number of inputs and key sources assigned to the control panel. This reduces control panel clutter and confusion, and is one of the factors allowing DYVI’s space-saving side-by-side layout of two or more Stages (or “M/Es”) to be assigned to the control panel.



DYVI “SCENES” MODE

However the real power of DYVI starts to emerge when a Production is set up that maps complex compositions of images and effects directly into single crosspoint buttons on the Control Panel. This is DYVI “Scenes” mode. A single DYVI Scene includes the following characteristics:

- It has a unique, user-configurable name.
- It can be a pre-composite of a background with multiple layers available for overlay, with their associated stored parameters recalled, along with any stored crop values, any 2D or 3D DVE transforms such as repositioning or scaling, and any associated branding, color correction, etc.
- When selected on the panel, the Scene “unpacks” the various buttons that allow selections to be made and changed within the Scene, such as key sources. Scenes can be set up to use any set of buttons anywhere on the panel; users can choose patterns of assignment that make sense for the production they are working on. As in Stage mode, the user can limit the number of sources assigned to the control panel to keep the group of buttons compact.
- A separate choice of transition types can be applied to each bus contributing to a Scene. For example, a dissolve, or a “mix-dissolve” (soft cut) can be applied to any bus, including the Program bus, without needing additional “M/E” resources. To give some examples, in the ‘News 2-box’ Scene in the center of Figure 12:
 - the background source behind ‘Sandy’ in the left box can be changed - not just with a cut, but also with a dissolve;
 - the type of transition occurring when changing Sandy’s background can also be changed, for example, to a dissolve, even if the Scene was originally constructed with a cut transition in this background;
 - this change in transition type can be done immediately without having to move the effect to another bus, e.g. in an upstream “M/E”, to get the dissolve
 - the foreground source in the same box can also be cut or dissolved, e.g. between ‘Sandy’ (a chroma key) and a character generator (a luminance key), on the same keyer.
 - other parts of the Scene can be altered just as easily
- In general, any part individually, or any combination of parts of a Scene, can have an individual choice of transition type, and can be delegated to manual or automatic transition control, from either of the two transition control areas provided on the control panel. For example, one keyed source could be mixed or cut in and out with the lever, or two keyed sources could be mixed in together, or several keys inside boxes could have their backgrounds transitioned at the same time, or all keys could be cut in as the background mixes up from black or some other previous background state using the Auto transition button. *All permutations are possible.*
- Scenes can be reused as parts of other Scenes.

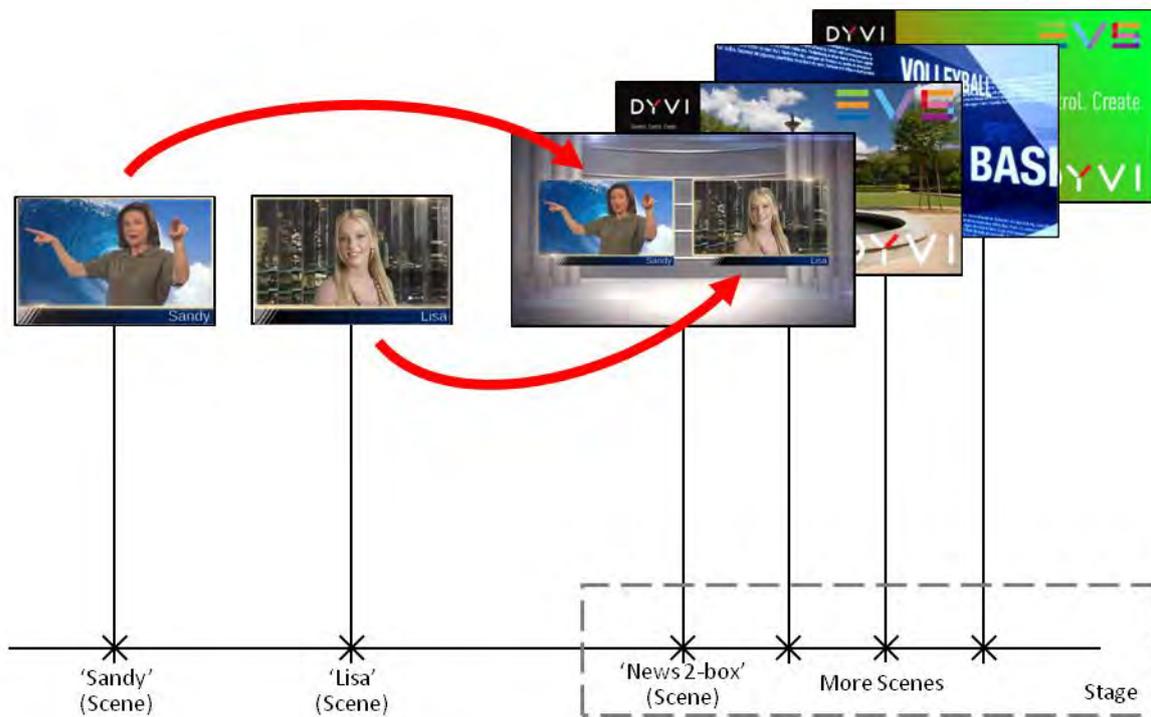


Fig 12. Scenes concept

Scenes mode is rather like having an entire Mix/Effects level packed into each Scene button, i.e. into just one crosspoint. What makes this economy in control panel space possible is the fact that, within the Scene, only the sources that could possibly be needed are included, instead of every crosspoint physically available on a bus row needing to be represented by a lit button. Yet, full control, such as choice of transition type, is available on every component of the composite image, without having to use up a large proportion of the switcher's total resources. The Scene reflects the creative requirements of the moment, not the entire possibilities that the hardware can provide.

With this economy of space, multiple Scenes can be loaded into the switcher and onto the control panel simultaneously. In fact, this is an even more powerful packaging of effects in DYVI, called "Story" mode.

There is nothing to prevent a user from combining these different modes in a customized way, as in fact Figure 12 shows. For example, in one style of Production Setup, a "Stage" may include a number of Scenes, the purpose of the "Stage" being to set aside always the same part of the Control Panel where the Scene's lit buttons (e.g. key sources) will be unpacked and laid out, if that is the user's preference.



DYVI “STORY” MODE

Stories can be assigned to any location on the control panel. As each Scene is activated and placed on air within the designated Program bus area, the next one, for preview, is placed within the designated Preset bus area, so the operator always knows what is coming next and can apply changes if necessary. This continues until the last Scene that is wanted is used. There is considerable flexibility when running in Story mode: Scenes don't necessarily have to be recalled in the exact order they appear on the control, or can be skipped altogether (for example, in the case of unavailability, or change of Show-Rundown, etc.), or can be recalled at any later time. Each Scene can be unpacked into its parts if any on-the-fly changes are needed.

With this mode, complete productions such as a news program can be built with just a small number of Scenes. The risk of on-air operator error is reduced, because each Scene comes with just the right inputs (and none of the wrong ones), each keyed window is correctly positioned and sized, and each source in the window recalls all key parameter settings. Even when a key source is changed within a window in the Scene, the new source comes with its own separately optimized and stored source settings, replacing those for the previous source, so the keyer is always operating optimally.

It is also possible to run DYVI with a number of different Stories lined up and ready to go. This is just a higher level of packaging, with each dedicated Story button now launching its own set of Scenes, each of which can be unpacked in turn when selected if any changes are needed – as described above - as the broadcast progresses.

OTHER DYVI OPERATIONAL FEATURES

SOURCE-BASED CLEAN FEED ARCHITECTURE

In traditional production switchers, a common method of preventing a particular source, e.g. a character generator, appearing on a clean feed output is to prevent that source's keyer being placed onto that particular output.

However, this method of identification by keyer can be restrictive to the workflow, while running the risk of errors. For example, if the keyer carrying a character generator is relocated to a different M/E, or an M/E is re-entered somewhere different, the “forbidden” character generator may then appear on the particular clean feed output, breaking its clean feed rule. The operator can prevent this happening by being very vigilant, but that can be very distracting from the main workflow.

The DYVI method is to identify instead the particular source that must never appear on one or more clean feed outputs. The rule is then applied globally to the source (say, a character generator), and moves with it, wherever it is keyed, on any bus anywhere in the switcher, so that if the operator inadvertently tries to put it onto a clean feed where it's not supposed to go, the rule is applied and the unwanted action is prevented.

CONDITIONAL MACROS

DYVI's macros can be edited to include conditions; execution of the next recorded step in the macro is then made conditional upon some particular switcher state occurring. An example would be a video server or clip player reaching a particular time code count in order to trigger the next macro step. Another would be a particular combination of some keys being on and some being off, but a condition could be almost anything.



Multiple macros can run at the same time, controlling different sections of the switcher. It is not necessary for one to run to its last step before another can be started.

Macros exist at the system level, so can be programmed, edited and run from a choice of places: from an assigned set of buttons on the control panel, or on any GUI.

SUMMARY

DYVI takes a scalable and modular approach to all aspects of live production switcher design that brings real benefits to the user.

MODULARITY IN ELECTRONICS AND CONTROL PANEL CONNECTIONS

The electronics frame, instead of being one large monolithic unit, is divided into a number of compact Processing Modules. When networked together, multiple Processing Modules create a combined virtual production switcher that acts as if it were one large physical unit, with all inputs from all modules available in one place, and all processing power from the individual modules combined. Alternatively, the total distributed switching and processing power can be divided up to make a number of smaller virtual production switchers, each customizable in its effective size. The Processing Modules can be separated from each other by short or extremely long distances. The Control Panels are also connected by networking, allowing them to be freely located, too.

One benefit of this modular, networked approach is that an outside broadcast can be done without a truck, since it is necessary only to send the cameras and one or more Processing Modules to accept their SDI video outputs.

The other major benefit of this modular hardware approach is that a DYVI system has no difficulty in handling productions involving multiple venues, whether separated as different studios and control centers in the same complex, or distributed in different countries around the world, as long as low latency fiber connections are available, because wide area network connectivity is an integral part of the system.



MODULARITY IN OPERATIONS

The use of a single point of video processing in the form of a GPU rendering engine in place of distributed processing in separated “Mix/Effects” units allows all switcher effects to become modular and relocatable in terms of layering priority and reuse in other effects. The benefits of this are first that it is not necessary for the user to have to think about moving an effect from one “M/E” to another in order to change priorities. Secondly, effects can be identified by name, individually stored and run as Scenes that occupy just small parts of the DYVI control panel. That allows a much smaller, more compact control panel, yet it will seem less crowded, because buttons will only be assigned to sources and effects that are actually needed; all unused resources will be kept out of the way; all buttons not needed will be left unilluminated, to increase the operator’s sense of focus on the Scenes and effects that have designed for the production.

Modularity in operations extends to levels of packaging:

- of sources, keyers, and their parameters and options into a user-named “Scene”
- of multiple Scenes into a “Story”
- of multiple Stories into a Production Setup that launches all the Stories making up a whole broadcast program

Any of these levels can be unpacked immediately on the fly to make changes as and when required on air.

THE LAST WORD

Finally, after decades of dormancy, production switcher design has been woken up, ready to face the challenges of this century.



LEGAL INFO

© 2013 EVS Broadcast Equipment, all rights reserved.

No part of this documentation or publication may be reproduced, transcribed, stored in a retrieval system, translated into any language, computer language, or transmitted in any form or by any means, electronically, mechanically, magnetically, optically, chemically, photocopied, manually, or otherwise, without prior written permission from EVS Broadcast Equipment.

DISCLAIMER

The information in this document is believed to be correct as of the date of publication. However, our policy is one of continual development so the information in this guide is subject to change without notice, and does not represent a commitment on the part of EVS Broadcast Equipment.

TECHNICAL SUPPORT

For the latest news, upgrades, documentation, and products, please visit the EVS website at www.evs.com.

LAST UPDATED

21 January 2015

CUSTOMER SUPPORT & TRAINING

Our clients range from TV stations to video equipment rental companies and production houses worldwide. EVS' key priority is to make sure that its clients keep performing at the highest possible level. We listen to our customers, identify operating workflows, anticipate needs, and suggest effective and reliable solutions, so that they in turn can offer top-quality productions to millions of TV viewers across the globe.

CUSTOMER SUPPORT

EVS is dedicated to making sure its products are functioning in a way that meets your needs and expectations. We offer technical support 24/7 from each of our regional offices, so you can rest assured that someone will always be available to answer any question that may arise.

All members of EVS' technical support team are qualified technicians with a solid background in broadcasting. They understand your requirements and can provide you with the best solution available.

TRAINING

Do you want to learn how to operate EVS systems and applications or enhance your skills in using our tools?

EVS Training offers a series of courses on how to operate its products, taught in-house by industry professionals. Some of the training sessions are conducted by the EVS team via a Web interface, so that you get hands-on instruction even at a distance. EVS User Guides and technical documents are available free-of-charge on our Website.



Corporate
+32 4 361 7000

North & Latin America
+1 973 575 7811

Asia & Pacific
+852 2914 2501

Other regional offices
www.evs.com/contact

EVS Broadcast Equipment is continuously adapting and improving its products in accordance with the ever changing requirements of the Broadcast Industry. The data contained herein is therefore subject to change without prior notice. Companies and product names are trademarks or registered trademarks of their respective companies.